CLAIMS

1. A process for removing contaminants from a natural gas stream, the process comprising the steps of:
(a) contacting part of the natural gas stream as a first gas stream at an elevated temperature with a first adsorbent bed in regeneration mode, to remove contaminants present on the first adsorbent bed, and to obtain a second gas stream that is enriched in contaminants compared to the first gas stream;
(b) submitting the second gas stream to a gas/liquid separation step comprising cooling the second gas stream to a temperature such that at least some contaminants begin to condense into a first liquid phase that is rich in contaminants, and separating the first liquid phase from the second gas stream to create a third gas stream; wherein the gas/liquid separation step forms a first gas/liquid separation step, and wherein the process further comprises
(c) submitting the third gas stream to a second gas/liquid separation step to obtain a second liquid phase that is rich in contaminants, and a lean gas stream.

2. The process according to claim 1, further comprising contacting another part of the natural gas stream with a second adsorbent bed in adsorption mode, to obtain a purified gas stream.

3. The process according to claim 2, wherein the lean gas stream is contacted with the second adsorbent bed together with the other part of the natural gas stream.

4. The process according to claim 2, wherein the lean gas stream is added to the purified gas stream.

5. The process according to any one of claims 1-4, wherein the lean gas stream has a cricondentherm lower than that of the natural gas stream, preferably at least 10 °C lower, more preferably at least 15 °C lower, most preferably at least 20 °C lower.

6. The process according to any one of claims 1-5, wherein the lean gas stream has a cricondentherm below 10 °C, preferably below 6 °C, more preferably below 0 °C, most preferably below -5 °C.

7. The process according to any one of claims 1-6 when dependent on claim 2, wherein the purified gas stream has a cricondentherm below 10 °C, preferably below 6 °C, more preferably below 0 °C, most preferably below -5 °C.

8. The process according to any one of claims 1-7, wherein the cooling in step (b) is done against a temperature above water freezing temperature, in particular using a water cooler.

9. The process according to any one of claims 2-8 when dependent on claim 2, wherein the temperature of the second adsorbent bed is between 5 and 45 °C, preferably between 20 and 30 °C.

10. The process according to any one of claims 1-9, wherein the temperature of the first adsorbent bed is between 200 and 350 °C, preferably between 250 and 325 °C, more preferably between 275 and 310 °C.

11. The process according to any one of claims 1-10 wherein step (c) comprises cooling the third gas stream to a temperature that is below a temperature at which contaminants in the third gas stream will begin to condense into a second liquid phase, and separating the second liquid phase from the third gas stream.

12. The process according to claim 11, wherein the third gas stream is cooled to a temperature below the cooling temperature in step (b), preferably to a temperature below 0 °C, more preferably to a temperature below -5 °C.
13. The process according to any one of claims 1-12, wherein the second gas/liquid separation in step (c) is effected by means of an accelerated velocity inertia separator.
14. The process according to claim 13, wherein the accelerated velocity inertia separator is a supersonic inertia separator and the fluid stream flows at supersonic velocity.
15. The process according to claim 14, wherein a swirling motion is induced to the fluid stream flowing at supersonic velocity, thereby causing the contaminants, in particular water and hydrocarbons, to flow to a radially outer section of a collecting zone in the stream.
16. The process according to claims 11, wherein the cooling of the third gas stream is effected by refrigeration.
17. The process according to claim 16 wherein a hydrate inhibitor, preferably methanol, is injected into the third gas stream prior to refrigeration.
18. The process according to any one of claims 1-17, wherein step (a) comprises
(a1) heating the first gas stream in a heating zone to obtain a heated first gas stream;
(a2) contacting the heated first gas stream with the first adsorbent bed in regeneration mode.
19. The process according to any one of claims 1-18, wherein the first gas stream is passed through a third adsorbent bed in cooling mode, prior to being contacted with the first adsorbent bed.

20. A system for removing contaminants from a natural gas stream, the system comprising:

- a first adsorption bed arranged to receive part of the natural gas stream as a first gas stream, and provided with a means for heating the first adsorbent bed, which first adsorption bed has an outlet for a second gas stream
- a cooler for cooling the second gas stream;
- a first gas/liquid separator for separating the cooled second gas stream into a first liquid phase and a third gas stream; and
- a second gas/liquid separator for separating the third gas stream into a second liquid phase and a lean gas stream.

21. The system according to claim 20, further comprising a second adsorbent bed arranged to receive another part of the natural gas stream at a temperature at which contaminants are adsorbed, and having an outlet for a purified gas stream.

22. The system according to claim 21, wherein the second adsorbent bed is arranged to receive the lean gas stream together with the other part of the natural gas stream.

23. The system according to any one of claims 20-22, wherein the first gas/liquid separator comprises a cooler arranged to condense liquid at a temperature above the freezing point of water, and wherein the second gas/liquid separator is arranged to separate contaminants that condense at a temperature lower than 0 °C.

24. The system according to any one of claims 20-23, wherein the second gas/liquid separator an accelerated velocity inertia separator, preferably a supersonic inertia separator.

for inducing a swirling motion the fluid stream entering this separator, thereby causing the contaminants, in particular water and hydrocarbons, to flow to a radially outer section of a collecting zone in the stream.

26. The system according any one of claims 20-23, wherein the second gas/liquid separator comprises a refrigerator.

27. The system according to any one of claims 20-26, wherein the means for heating the first adsorbent bed comprises a heater for the first gas stream.

28. The system according to any one of claims 20-27, further comprising a third adsorbent bed arranged to receive the first gas stream prior to the first adsorbent bed.